



Overfishing and Aquaculture- 8th Grade

Purpose

- Students will be able to explain why overfishing has occurred in our oceans, describe the effects of overfishing on fish stocks, and create a plan to manage overfishing.
- Students will be able to graph changes in a population over time.
- Students will create a visual public service poster, set a purpose, consider audience and develop focused ideas for a specific purpose and exhibit personal style, voice and design to enhance the written informational content.

Subject Area(s)

Science, Math, ELA

Common Core/Essential Standards:

Science

- **8.E.1:** Understand the hydrosphere and the impact of humans on local systems and the effects of the hydrosphere on humans.
 - **8.E.1.1** Explain the structure of the hydrosphere including: Water distribution on earth. Local river basins and water availability
 - **8.E.1.2** Summarize evidence that Earth's oceans are a reservoir of nutrients, minerals, dissolved gases, and life forms: estuaries, marine ecosystems, upwelling, behavior of gases in the marine environment, value and sustainability of marine resources, and deep ocean technology and understandings gained
 - **8.E.1.3** Predict the safety and potability of water supplies in North Carolina based on physical and biological factors, including: temperature, dissolved oxygen, pH, nitrates and phosphates, turbidity, and bioindicators
 - **8.E.1.4** Conclude that the good health of humans requires: monitoring of the hydrosphere, water quality standards, methods of water treatment, maintaining safe water quality, stewardship
- **8.L.5:** Understand the composition of various substances as it relates to their ability to serve as a source of energy and building materials for growth and repair of organisms.
 - 8.L.5.1 Summarize how food provides the energy and the molecules required for building materials, growth and survival of all organisms (to include plants).

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- **8.L.5.2** Explain the relationship among a healthy diet, exercise, and the general health of the body (emphasis on the relationship between respiration and digestion).

Mathematics

- **CCSS.MATH.8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

English Language Arts

- **CCSS.ELA-Literacy.SL.8.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade level topics, texts, and issues, building on others' ideas and expressing their own clearly.
- **CCSS.ELA-Literacy.SL.8.1** Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

Agricultural Literacy Outcomes

Agriculture and the Environment

- Evaluate the various definitions of “sustainable agriculture,” considering population growth, carbon footprint, environmental systems, land and water resources, and economics.

Food, Health and Lifestyle

- Identify agricultural products (foods) that provide valuable nutrients for a balanced diet.

Science, Technology, Engineering and Mathematics

- Identify science careers related to both producers and consumers of agricultural products.
- Predict the types of careers and skills agricultural scientists will need in the future to support agricultural production and meet the needs of a growing population.

Essential Questions

1. What is overfishing?
2. Why is overfishing a problem?
3. What is sustainability?

Vocabulary

Aquaculture: the cultivation of aquatic organisms (such as fish or shellfish) especially for food

Overfishing: to fish to the detriment of a fishing ground or to the depletion of a kind of organism

Stewardship: the conducting, supervising, or managing of something; the careful and responsible management of something entrusted to one's care

Sustainability: relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged

Bycatch: the portion of a commercial fishing catch that consists of marine animals caught unintentionally

Tuna: any of numerous large vigorous scombroid food and sport fishes, such as an albacore or a bluefin tuna

Salmon: a large anadromous salmonid fish of the North Atlantic noted as a game and food fish, also called *Atlantic salmon* or any of various anadromous salmonid fishes other than the salmon, also called *Pacific salmon*

Black Sea Bass: an abundant and important food fish (*Centropristes striatus*) of the Atlantic coast of the U.S. that is dark bluish with black bands and more or less varied with small white spots and blotches, also called *sea bass*

Mollusk: an invertebrate that includes snails, slugs, mussels, and octopus.

Mussel: bivalve mollusk with brown or black shell.

Oyster: bivalve mollusk with rough irregular shell - many can be farmed for eating or harvesting pearls.

Clam: a marine bivalve mollusk.

Bivalve: aquatic mollusk whose body is enclosed in a hinged shell, such as oysters, clams, mussels, and scallops.

Scallop: edible bivalve mollusk with a ribbed fan-shaped shell.

Student Motivator

Begin a discussion with the class by asking the students if there is a difference between fishing and farming. Some questions to guide your discussion might be *What is farming?*, *What is fishing?*, *How are fishing and farming different/the same?*, *What do you know about farm-raised fish?* Students can discuss as a class or teacher can allow students to write ideas down on post-it notes and place them on a whiteboard for further discussion.

Background Knowledge

Aquaculture is the business of farming aquatic plants and animals. In North Carolina, farmers grow trout, catfish, hybrid striped bass, crawfish, yellow perch, prawns, ornamental fish, bait fish, clams and oysters. Farms for freshwater fish typically consist of square or rectangular earthen ponds or, for trout, ponds or tanks which are much longer than they are wide. Farmers stock these ponds and tanks with

small fish, then feed and care for them until ready for harvest and sale to the consumer. Clam and oyster farmers use the natural sea bottom as their growing environment, and either plant small shellfish or move existing shellfish to areas better suited for their growth. Over 200 North Carolina families earn at least a part of their living through aquaculture, and the industry is worth nearly \$25 million dollars to the state's economy in farm sales alone.

The development of U.S. aquaculture is critical to maintaining the long-term sustainability of wild caught fisheries and the environment. It is estimated that wild caught fisheries have reached maximum sustainable yield, while the world's appetite for seafood is growing. Our aquaculture industry can satisfy the growing demand for seafood in an environmentally friendly and sustainable manner. There are even examples of aquaculture actually improving the environment. U.S. aquaculture operations raise fish such as trout, tilapia, barramundi, and cobia that can replace more familiar species on menus yet meet customers' wants and needs. Other farms are raising traditional marine species such as cod, flounder, and halibut. The availability of these species allows fish stocks to recover and allows wild harvest commercial fishermen to work closely with government agencies to help ensure that those stocks aren't overfished in U.S. waters. In the U.S., fish farms along the coast are not located in environmentally sensitive areas. The National Marine Fisheries Service identifies areas that are considered essential to living marine resources and regulates the use of those areas to help ensure that those habitats remain healthy and can support sustainable fisheries.

The production of bivalve mollusks and shellfish (clams, oysters, and mussels) provides positive environmental impacts. These shellfish remove nutrients from the water by feeding on algae and particulate matter. This helps to maintain good water quality and minimizes the loss of oxygen, which is critical to the survival of other organisms. While farmed shellfish are growing, they spawn and help to reseed wild shellfish beds. Because of their three-dimensional structure, shellfish form habitats and hiding places for other organisms, adding to the biodiversity of the marine environment. These impacts are so important that in some areas, community volunteers are restoring oyster and clam populations.

Materials

- Colored Goldfish crackers
- Paper plates
- Napkins/paper towels
- Spoons
- String
- Roll of tape
- Data tables for students

- Chart paper
- Markers
- Access to technology

Procedures

Activity 1

1. Begin class with a discussion of fishing. Examples of question may include: *What fish do you eat? What do you know about where the fish came from and how they were caught?*
2. Introduce today's activity and review the rules of this food web with the students. In this ocean's food web the plain yellow Goldfish eat seaweed of which there is always plenty, the green Goldfish fish and red Goldfish eat the yellow Goldfish, and the dark Orange Goldfish eat both green Goldfish and red Goldfish. (There must be at least 2 Goldfish in the ocean for these fish to survive. You may or may not want to share this with the students.)
3. Inform the students that each fish has a dollar value, and the purpose is to make money. A yellow goldfish will make a profit of \$2, red goldfish will make a profit of \$5, green goldfish will make a profit of \$5, and dark orange goldfish will make a profit of \$10.
4. Pass out the simulation rules and data tables. Have one person from each group collect a plate, 4 spoons, 4 straws, 4 napkins, 4 pieces of string and a roll of tape for the members of their group (of 4 students). Students may use the spoons, straws, strings and/or tape to create any fishing pole they would like. The key is to get fish out of the ocean and onto their napkin (aka boat).
5. The teacher will start off each ocean with: 8-10 of each colored Goldfish. (Numbers can be adjusted as teacher sees fit.)
6. When all oceans are stocked, fishing poles made, and groups are ready the teacher will say, "Go." Students will have 30 seconds to fish and then the teacher will signal or say, "Stop." All fishing poles must be put down. Any fish on the table or still attached to the fishing pole do not count. Any fish destroyed in fishing do not count.
7. Students should fill in their data tables with the number of each species of fish that remains in the ocean and the number and value of their catch (see data table in essential files). Once their tables are filled out, they can eat their Goldfish, if they would like.
8. As they fill in the tables, the teacher will go around and adjust the number of fish in each ocean for the next round. However, there must be a food source and 2 fish of that species for them to reproduce and survive.
9. Repeat steps 6-8 three more times until there have been four years of fishing.
10. Students will work on creating a line graph to show changes in their fish population over time. This may help students think about their own ocean before comparing the results between groups.

11. Have each group report to the class the final number of fish remaining in their oceans after year four. Some oceans may be completely empty of fish. Others may have established a way to fish sustainably so there are many more fish than when they started. Discuss the various strategies the different groups used (or didn't use) to manage their oceans.
12. Introduce the concepts of overfishing, sustainability, and managing our resources as they become relevant to the discussion.
13. Option: Introduce the book, *World Without Fish*. This book could be used for a book study or as a resource for teachers and/or students.

Activity 2

1. Have students research Aquaculture using the book *World Without Fish*, the [United States Aquaculture Fact and Fiction pdf](#), the website [Monterey Bay Seafood Watch](#), and the TED Talks "[The four fish we're overeating- and what to eat instead](#)" and "[The case for farm fishing](#)", and/or other resources listed.
2. Tell students they will create a Public Service Announcement (PSA). PSAs are messages in the public interest, which are on television, radio, print or other media. The purpose of commercial advertising is to market a product or service. PSAs are messages that benefit the public by raising awareness of an issue and influencing attitudes or actions for the good of mankind. The media time and space is provided for free. Students will create a PSA poster that encourages the community to eat fish sustainably.
3. Possible poster guidelines teachers may use to guide students are : why is seafood a healthy protein source, why overfishing is a problem, why farm raised fish are a healthy option, what sustainable fishing is, and/or why is aquaculture considered a future food source. A rubric can be found in the essential files.
4. Students will present posters to class, or share via gallery walk.

Suggested Companion Resources

- *World Without Fish* by Mark Kurlansky
- TED Talk- The four fish we're overeating- and what to eat instead
https://www.youtube.com/watch?v=_jaWs87t5UM
- TED Talk- The case for farm fishing
<https://www.youtube.com/watch?v=a7cDt5r2pGY>
- North Carolina Field and Family: Aquaculture Programs Help Students Dive in to Careers <http://www.ncfieldfamily.org/farm/aquaculture/aquaculture-programs-help-students-dive-careers/>
- National Aquaculture Association: United States Aquaculture Fact vs. Fiction brochure

<http://thenaa.net/pub/United-States-Aquaculture-Fact-Fiction.pdf>

- Monterey Bay Seafood Watch
<http://www.seafoodwatch.org/about-us>
- TED Talk- Oysters: The sustainable seafood
<https://youtu.be/1kE18X7pRSM>

Essential Files

- [Data Sheet for students](#)
- [Rubric](#) for PSA Poster

Essential Links

- North Carolina Sea Grant
<https://ncseagrant.ncsu.edu/>
- NOAA Fisheries
<http://www.noaa.gov/fisheries>
- North Carolina Aquaculture <http://www.ncagr.gov/markets/aquaculture/documents/2015NCADCUpdateMASTER.pdf>
- North Carolina Department of Agriculture and Consumer Services
<http://www.ncagr.gov/markets/seafood/general.htm>

Ag Facts

- NC farmers grow trout, catfish, clams, oysters, southern flounder, and black sea bass, among others.
- The aquaculture industry in North Carolina has a total farm gate value of \$60 million, which includes fish production, processed product and feed produced (2015).
- NC produces both freshwater and saltwater products.
- Poor water quality and loss of habitat have led to the decline of oyster harvesting.
- Over 200 North Carolina families earn at least a part of their living through aquaculture, and the industry is worth nearly \$25 million dollars to the state's economy in farm sales alone.
- Trout farming is the oldest form of commercial fish production in the U.S., dating back over 150 years. Trout are usually grown in concrete raceways (narrow tanks) or ponds with a constant supply of cold, flowing water. North Carolina is second only to Idaho in U.S. trout production, and had 41 operations supplying nearly 3.6 million pounds (valued at about \$5.5 million) in 2008.

- North Carolina farmers harvested about 8.4 million pounds of catfish, worth about \$7.1 million to the farmer in 2008. The Southeast and Mid-Atlantic are still the biggest markets for sales of North Carolina catfish, but the largest processor in the state also exports to Europe and Asia.
- In 2008, 4,467 bushels of clams and 10,048 bushels of oysters, with an estimated value of over \$500,000 were harvested from 1,909 leased acres.

Extension Activities

- Have students create a digital PSA from the poster via prezi or video by using editing tools like Movie Maker, iMovie, Explain Everything, Vimeo, or Spark Video. Assign roles such as producer, actor/narrator, set designer/graphics designer, etc. Here is an example: [Overfishing PSA](#)
- Have students visit a fish research facility and/or interview local fishers, fish biologists or other people involved with local fisheries.
- Have students research oysters and how oyster farming can produce a positive impact on water quality.

Sources and Credits

- Food From the Ocean Lesson Plan
<https://www.ncagintheclassroom.com/Portals/1/pdf/curriculum/LessonPlanFoodfromtheOcean.pdf?ver=2015-11-03-113836-397>
- The Lifespan of Overfishing
http://www.blueworldtv.com/images/uploads/lesson-plans/Lesson_Plan_Webisode14Clams.pdf
- NOAA Fisheries Farmed vs. Wild Systems
http://www.nmfs.noaa.gov/stories/2012/10/docs/farmed_vs_wild.pdf
- National Aquaculture Association
<http://thenaa.net/why-choose#stewardship>
- North Carolina Department of Agriculture and Consumer Services
<http://www.ncagr.gov/markets/seafood/general.htm>
- East Coast Shellfish Growers Association
<http://www.ecsga.org/Pages/Sustainability/CultureBenefits.htm>
- World Wildlife Fund- Overfishing- Threats
<https://www.worldwildlife.org/threats/overfishing>
- North Carolina Field and Family- North Carolina Fish Facts (2012)
<http://www.ncfieldfamily.org/farm/north-carolina-fish-facts/6/>